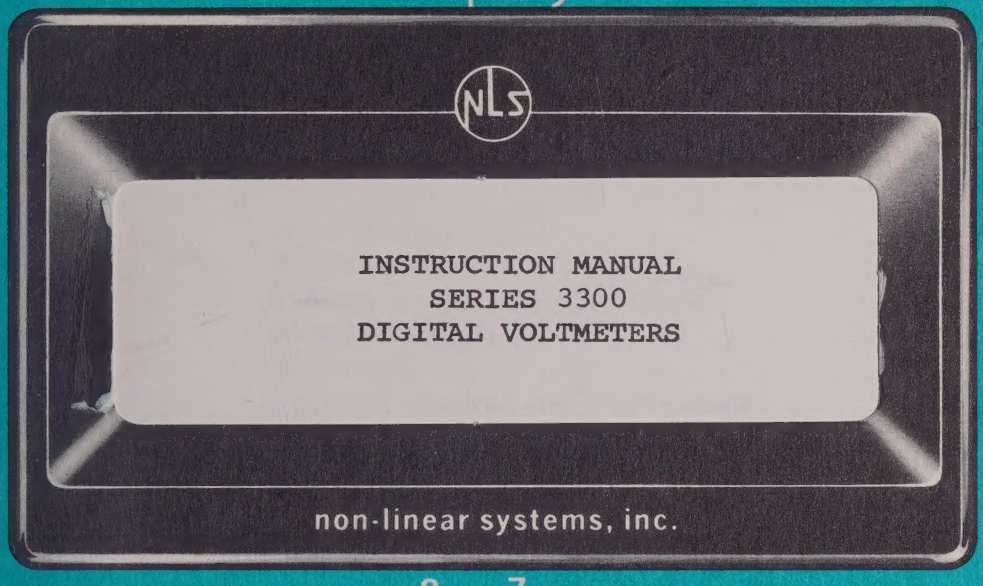

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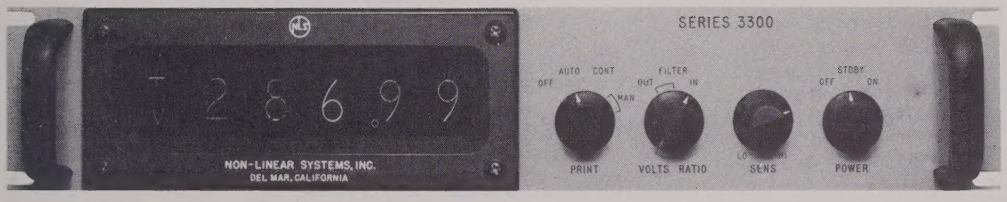
MP MASTER
MA33779

J Fanelli

Document No. 567A
Revised January 1966

INSTRUCTION MANUAL
SERIES 3300
DIGITAL VOLTMETERS



Originator of the Digital Voltmeter

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DEL MAR , CALIFORNIA

TABLE OF CONTENTS

Section	Title	Page
I	Introduction	1-1
	Specifications	1-1
II	Installation and Operation	2-1
	Unpacking	2-1
	Power Source	2-1
	Fusing	2-1
	Power Grounding	2-1
	Controls	2-1
	Typical Operating Procedure	2-4
	Printer Operation	2-5
III	Calibration	3-1
	Equipment Required	3-1
	Filter Compensation	3-3
	Ranging	3-3
IV	Maintenance	4-1
	Appendix	A-1
	Shipping Instructions	A-1
	Claim for Damage in Shipment	A-1

LIST OF ILLUSTRATIONS

Number	Title	Page
2-1	Printer Connections for Decades, Print Command, and Print Complete	2-6
3-1	Top View of Typical Series 3000 Digital Voltmeter with Outer and Inner Covers Removed	3-2

LIST OF TABLES

Number	Title	Page
1-1	Models of the Series 3300 Digital Voltmeters	1-3
2-1	Pin Locations for Data Recording Functions	2-7

LIST OF SCHEMATIC DIAGRAMS

33-46 Bridge Relay Board Assembly
4110 (Chg 0) Model 3300 Digital Voltmeter
4110 (Chg 1) Model 3300 Digital Voltmeter
4783 Model 3333 Digital Voltmeter
4791 Model 3341 Digital Voltmeter
5419 Print Closure and Remote Function

SECTION I

INTRODUCTION

Series 3300 Digital Voltmeters are versatile reed-relay instruments having a wide range of measuring capabilities and a high level of common-mode noise rejection. These instruments are ideally suited for applications requiring the high-level accuracy associated with other NLS instruments, but where space must be saved the 3300 Series instruments are of added value since they occupy only 3½ inches of rack space. The models which have built-in circuits for measuring AC, ohms, or both, occupy only 5¼ inches of rack space; this is an increase of only 1-3/4 inches for this added capability.

The Model 3330 serves as a basis for describing other instruments in the series because it is the most complex instrument. For other models, see the Table 1-1 in this section to find which circuits, functions, and controls mentioned are to be disregarded.

If there is difficulty operating, calibrating, or adjusting the instrument, contact an NLS Field Service office or the Main Office in Del Mar, California.

SPECIFICATIONS

See Table 1-1 for measurement functions, ranges, and characteristics of each model in this series.

RANGES: Four-Digit Models: ±.9999/9.999/99.99/999.9 volts DC (3-range models do not have a .9999 range); ±.9999 DC voltage ratio (1-volt input).

ACCURACY: ±(0.01% of reading + 1 digit).

INPUT IMPEDANCE: 10 megohms at balance; 1000 megohms for DC voltage ratio. 100 kilohms for external DC ratio reference voltage.

RANGE AND POLARITY CHANGING: Automatic, manual, or fixed, depending upon model.

EXTERNAL REFERENCE VOLTAGE FOR RATIO MEASUREMENT: ±1 volt for four-digit models, ±10 volts for five-digit models.

GROUND ISOLATION: Signal leads can be floated 1000 volts above outer case.

COMMON MODE REJECTION: 100 or 120 DB (depending upon specific model) at 60 CPS.

INPUT FILTER: A two-section L-C type filter attenuates input signal noise. The filter can be switched in and out of the input circuit.

DIGITAL OUTPUT (PRINT): Contact closures (DCC) or voltage levels (DVL) in parallel decimal code. Logic "1" = +12 volts; logic "0" = 24 volts. Maximum current drain 10 MA per line. Contact closures in 8-4-2-1 code also available upon request.

AC AND OHMS MEASUREMENTS: Over-all accuracy is converter accuracy plus DC DVM accuracy. Converter is built into AC and ohms models in 3300 Series.

REMOTE CONTROL: The switching functions of front panel controls can be performed by remote electrical signals in some models

PRIMARY POWER: 115 volts, 50-60 CPS.

WEIGHT: Approximately 40 pounds net, 60 pounds shipping.

DIMENSIONS: 3½ inches high, 20 inches deep, 19 inches wide, for rack or bench use. AC and ohms models are 5¼ inches high.

Table 1-1. Models of the Series 3300 Digital Voltmeters

MODEL	MEASURES				NO. OF		FUNCTION CONTROLS					
	Volts DC	Ratio DC/DC	Volts AC Man Range	Ohms Man Range	Digits	Ranges	Polarity Control	Range	Printer	Remote	Filter	CMR at 60 CPS in Decibels
3301	V	-	-	-	4	3	M	M	-	-	S	-
3302	V	-	-	-	4	3	M	M	DVL	-	S	-
3303	V	R	-	O	4	3	M	M	-	-	S	100
3304	V	-	-	-	4	3	A	A	-	-	S	120
3305	V	-	AC	-	4	3	A	AM	DCC	REM	S	120
3306	V	-	-	O	4	3	A	AM	DCC	REM	S	120
3307	V	R	AC	O	4	3	A	AM	DCC	REM	S	120
3308	V	-	-	-	4	3	A	AM	DCC	REM	S	120
3309	V	-	-	-	4	3	A	AM	-	REM	S	120
3310	V	R	-	-	4	3	A	AM	DCC	REM	S	120
3311	V	R	-	-	4	3	A	AM	-	REM	S	120
3312	V	-	-	-	4	4	A	AM	-	-	S	100
3313	V	-	-	-	4	4	A	AM	DCC	REM	S	100
3314	V	R	-	-	4	4	A	AM	-	-	S	100
3315	V	R	-	-	4	4	A	AM	DCC	REM	S	100
3316	V	-	AC	-	4	4	A	AM	-	-	S	100
3317	V	-	AC	-	4	4	A	AM	DCC	REM	S	100
3318	V	-	-	O	4	4	A	AM	-	-	S	100
3319	V	-	-	O	4	4	A	AM	DCC	REM	S	100
3320	V	R	AC	O	4	4	A	AM	DCC	REM	S	100
3321	-	R	-	-	5	1	A	F	-	-	-	100
3322	V	-	-	-	5	3	A	AM	-	REM	S	100
3323	V	-	-	-	5	3	A	AM	DCC	REM	S	100
3324	V	R	-	-	5	3	A	AM	-	-	S	100
3325	V	R	-	-	5	3	A	AM	DCC	REM	S	100
3326	V	-	AC	-	5	3	A	AM	-	-	S	100
3327	V	-	AC	-	5	3	A	AM	DCC	REM	S	100
3328	V	-	-	O	5	3	A	AM	-	-	S	100
3329	V	-	-	O	5	3	A	AM	DCC	REM	S	100
3330	V	R	AC	O	5	3	A	AM	DCC	REM	S	100
3331	V	-	-	-	5	3	M	M	-	-	-	100
3332	V	R	-	-	5	3	A	AM	DVL	-	S	-
3333	V	R	AC	-	5	3	A	A	DCC	-	S	100
*3338	V	-	-	-	4	1	A	F	DCC	-	-	100
3339	V	R	AC	-	5	3	A	AM	-	-	S	100
3340	V	R	AC	-	5	3	A	AM	DVL	-	S	-
3341	V	R	-	-	5	3	A	A	DCC	-	S	100
3342	V	R	AC	O	5	3	A	AM	-	-	S	100
3343	V	R	-	-	4	4	A	A	DCC	-	S	100
3344	V	R	AC	O	5	3	A	AM	DCC	REM	S	100

*100 UV resolution

A = automatic
AM = automatic and manual
DCC = decimal contact closures
DVL = decimal voltage levels
F = fixed
REM = remote
S = switchable

SECTION II

INSTALLATION AND OPERATION

UNPACKING

Instruments are shipped in two-piece polystyrene-bead containers. Cut tape between container halves and open. If damage is seen, promptly notify carrier. There is no packing material inside the instrument.

POWER SOURCE

The instrument is ready for operation from conventional 115-volt, 60-cycle power sources. A 230-volt source may be used if the two primaries of the power transformer are wired in series instead of in parallel. Schematic identifies windings.

FUSING

A 3 AG, 0.5 ampere slo-blo fuse in an extractor post on the rear panel protects the instrument. With AC and ohms measuring instruments, it is recommended that a 1 ampere slo-blo fuse be used.

POWER GROUNDING

Third pin on power plug grounds instrument. If using adapter, ground third pin with wire to outlet box or plate. Do not cut third pin.

CONTROLS

The number and type of front-panel controls used is determined by measuring capability. Since Model 3330 has more capabilities than other instruments in the series, a description of its controls suffices for other instruments.

The POWER switch has three positions:

OFF - In this position the instrument is de-energized.

STANDBY - In this position the instrument is inoperative, but is kept warm, ready to make accurate readings. The display will show whatever value has been computed and displayed at the moment that the control is set at this position. In this way, particular readings may be preserved indefinitely.

ON - In this position the instrument is fully energized and is able to perform measuring functions.

The **PRINT** switch has four positions:

OFF - In this position the instrument is operative and the readout display will give correct indications, but the data-recording circuits are disabled.

AUTO - In this position the instrument will display a reading and the data-recording contact closures needed for printers and other devices are energized. The readout will display whatever value is provided at the input and the printer will operate only when the input value changes.

CONT. - In this continuous position the instrument will operate at its full speed; the readout will display the input value while simultaneous contact closures are made to operate a data recorder. Operation in this position is continuous whether or not the input value changes.

MAN. - When set at the manual position, the instrument will make a reading and print one time and then remain in standby until the control is rotated clockwise to the spring-return position and released to enable another read-and-print operation.

The **VOLTS-RATIO-FILTER** switch has three positions:

VOLTS, FILTER IN - connects a double-section R-L-C filter in series with the input. This filter provides 60 DB attenuation at 60 cycles. This position also switches the correct relays to measure voltage.

VOLTS, FILTER OUT - switches out the filter network and switches in a compensating potentiometer in series with the input. This potentiometer is set at the factory and requires no further adjustment unless filter components have been replaced. If the adjustment has been altered, it may be corrected by following instructions given in the calibration section.

RATIO, FILTER OUT - switches out the filter and switches in the compensating potentiometer described above. This position also switches the proper relays to operate the instrument in the ratio mode when an external reference voltage is applied through the reference cable.

The **FUNCTION** switch has three positions:

NOTE

For all positions of the **FUNCTION** switch the **VOLTS-RATIO-FILTER** switch must be in one of the two **VOLT** positions.

DC - In this position DC voltage measurements are made.

AC - In this position AC voltage measurements are made; the range must be selected manually. AC readings are not displayed in the left-hand window. If too high a value of AC is applied at the input, the left-hand window will illuminate with a red digit 1, indicating that the instrument must be set at a higher range. Although excess voltage can be tolerated without harming the instrument, the reading will not be accurate unless the **RANGE** switch is set correctly.

K-OHMS - In this position the ohms-measuring circuitry is connected so that resistance measurements may be made. As with AC reading, the **RANGE** switch must be set correctly.

The RANGE switch has four positions:

AUTO DC - In this position the instrument will automatically select the range required by the input value and the decimal point will shift; this position is not used for AC VOLTS or K-ohms measurements.

10, 100, 1000 - These positions fix the range of the instrument to read input values of 0 to 10, 10 to 100, and 100 to 1000. These positions are used for DC Volts, AC Volts, K-Ohms, and Ratio.

The SENS control is a potentiometer used to desensitize the instrument while readings are being taken in the presence of rapidly changing values, or in the presence of spurious signals. The normal position for this control is in the full clockwise position. When necessary, this control may be backed off as far as needed to stabilize the signal after which it is to be returned to its normal full-clockwise setting.

TYPICAL OPERATING PROCEDURE (MODEL 3330)

In order to properly use the instrument, a list of settings for the various measuring capabilities are outlined:

- DC volts operation (local control)
  VOLTS-RATIO-FILTER switch - VOLTS, FILTER IN (or OUT)
  SENSITIVITY - HI
  POWER switch - ON
  RANGE switch - appropriate position
  FUNCTION switch - DC
  Connect the input cable (NLS Part No. 5123) as follows:
  RED - Signal High
  BLACK - Signal Low
  YELLOW - Guard Shield
  BLUE - Chassis Ground
- Ratiometer operation (local control)
  VOLTS-RATIO-FILTER switch - RATIO
  All other controls - same as for DC volts operation.
  Connect the External Reference Cable (NLS Part No. 5124) as follows:
  RED - Positive reference
  YELLOW - Reference common (signal low)

BLACK - Negative reference
BLUE - Chassis ground

- AC Volts (local control)
  FUNCTION switch - AC
  RANGE switch - 10, 100, or 1000 -- depending upon value of input.
  All other controls - same as for DC volts operation.
- K-Ohms (local control)
  FUNCTION switch - K-OHMS
  All other controls - same as for AC volts operation.

PRINTER OPERATION

Connections to a data recorder, such as the NLS Model 155 Printer, are made through a 75-pin connector at the rear of the Digital Voltmeter. When a voltage is being displayed, appropriate reed relays in the instrument are energized, making available contacts to which a printer, remote read-out, punch, or other device may be wired. These relays are isolated from the inner box and therefore the use of external equipment through these contacts will not lessen the common-mode rejection capability of the instrument.

When the instrument is connected to a printer or other external device, connections are made as shown in Figure 2-1.

AUTO MODE - Set the PRINT switch at AUTO. In this position, the voltmeter will reach a balance, issue a print command, remain in standby until the print-complete signal is received, and then issue no further print command until the value of the input changes.

CONTINUOUS MODE - Set the PRINT switch at CONT. In this position, the voltmeter will reach a balance, issue a print command, and remain in standby until a print-complete signal is received from the external printer (or from other source). If the value of the input changes, the instrument will again seek a balance and print again at specified speed. If the input value has <u>not</u> changed, the instrument will continue to issue print commands at an approximate one-per-second rate.

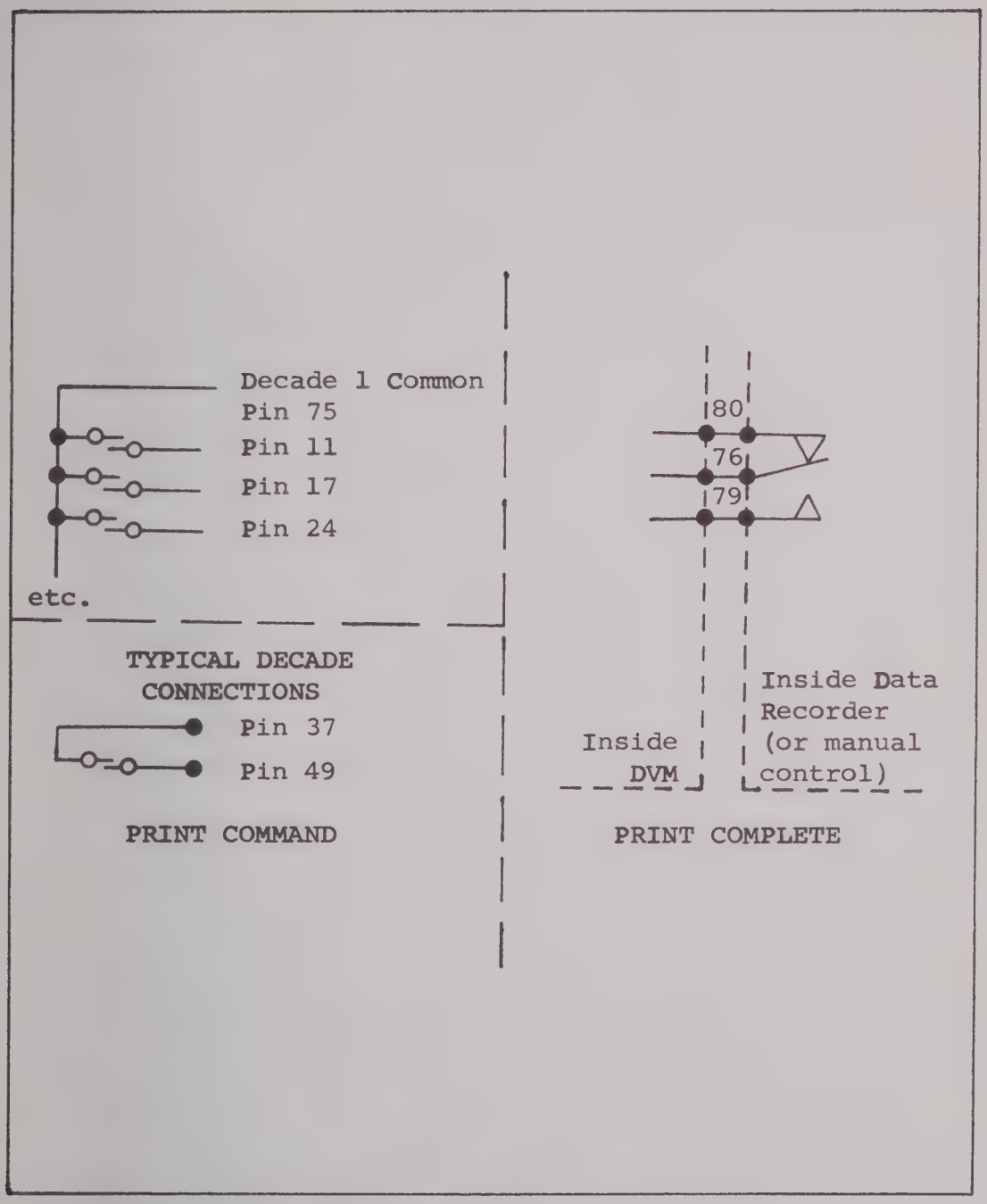


Figure 2-1. Printer Connections for Decades, Print Command, and Print Complete

SINGLE-PRINT MODE - Set the **PRINT** switch at **MAN** (manual), and rotate clockwise to its spring-return position, then release. The switch will return to **MAN**. When this is done, the instrument will balance, issue one print command, and remain in standby until the procedure is repeated or until the instrument is switched to **AUTO** or **CONT** mode.

CAUTION

Do not exceed the current rating of the reed relays used for operating printers. Maximums are 0.5 amp., or 250 VDC, or 10 watts.

Table 2-1 and Figure 2-1 give the correct pin locations for all data recording functions.

Table 2-1. Pin Locations for Data Recording Functions

DIGIT	UNIT*	TENS	HUNDREDS	THOUSANDS	TEN THOUSANDS
0	11	14	10	13	8
1	17	21	16	20	15
2	24	27	23	26	22
3	30	33	29	32	28
4	36	39	35	38	34
5	42	45	41	44	40
6	48	51	47	50	46
7	54	57	53	56	52
8	60	64	59	63	58
9	67	72	66	71	65
Common	75	78	74	77	73

4-DIGIT, 4-RANGE MODELS	PIN
Decimal for 1 Volt Max.	5
Decimal for 10 Volt Max.	2
Decimal for 100 Volt Max.	7
Decimal for 1000 Volt Max.	3

POLARITY SIGNS	
+ Symbol	- Pin 18
- Symbol	- Pin 25
+,- Common	- Pin 12

5-DIGIT, 3-RANGE MODELS	PIN
Decimal for 10 Volt Max.	5
Decimal for 100 Volt Max.	2
Decimal for 1000 Volt Max.	7

FUNCTION SYMBOLS	
OHMS	- Pin 43
VOLTS DC	- Pin 62
RATIO	- Pin 55
COMMON	- Pin 82

*The Units decade is not used with three-digit instruments

SECTION III

CALIBRATION

When a 3300 Series instrument is not making readings within specifications, it is time for calibration, repair, or both. In the calibration information given in this section, it is assumed that the instrument is in good working order.

The instructions given are minimal and do not take into account the amplifier gain and balance adjustments, since these are factory set and should require no adjustment unless a related component has been replaced. If the gain and balance settings have been inadvertently altered, the NLS Service Center should be called upon to make adjustment. In addition, certain models within the 3300 Series are equipped with converters to provide ohms and/or AC readings; these converters have their own adjustments and no attempt should be made to adjust the converter circuits without consulting the separate converter data which accompanies the AC and ohms measuring instruments in the series.

The physical location of each adjustment potentiometer is shown in Figure 3-1 and, while the picture shows the instrument with both the inner and outer covers removed, all adjustments are to be made through holes located in the top inner cover. The reference adjustment should be made with an insulated screwdriver since the reach required is fairly long and the screwdriver must pass very close to circuits against which it can short.

Follow all steps in the sequence listed.

EQUIPMENT REQUIRED

1. Stable, but not necessarily precise, sources of 10, 100, and 1000 volts DC.

2. A decade voltage divider, such as the Dekavider, Model DV-411.

3. A bank of nine standard cells, such as the NLS P/N 3006.

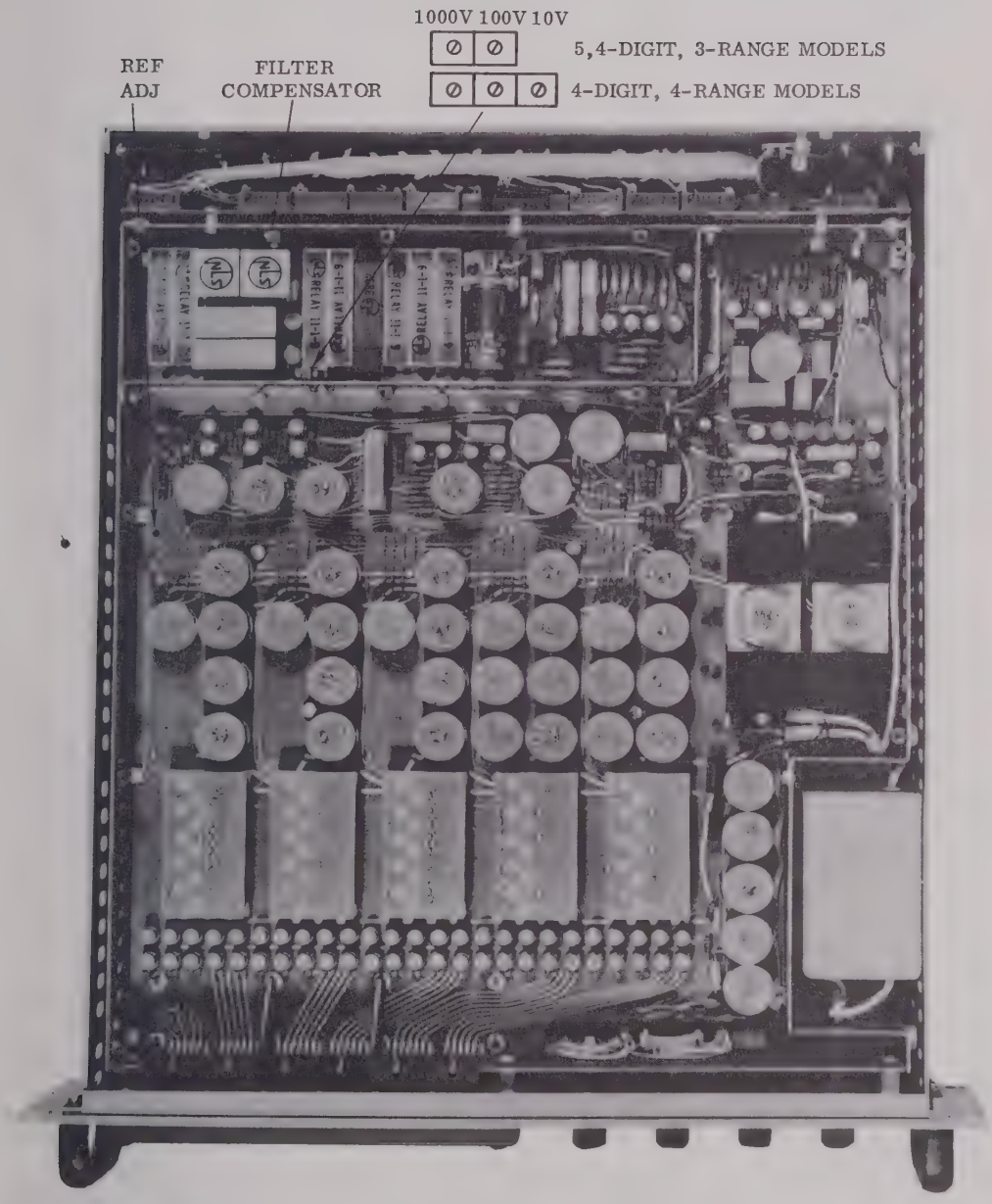


Figure 3-1. Top View of Typical Series 3000 Digital Voltmeter with Outer and Inner Covers Removed

4. A ratio box with precise divisions of 10:1 and 100:1, such as the NLS P/N 3020.

Turn on the voltmeter and allow it to warm up for 30 minutes with the top and bottom covers on.

FILTER COMPENSATION

1. Apply any conveniently available, but steady, source of DC to the input, RED pin of the input cable to positive, BLACK to the negative; set the SENS fully clockwise, FUNCTION to DC, RANGE to 10, 100, or 1000 (as required by the input value), and PRINT to OFF.

2. Set the FILTER switch to VOLTS, filter IN, and observe the reading.

3. Set the FILTER switch to VOLTS, filter OUT and again observe the reading. The value should be the same as displayed in Step 3. If it is not, the filter compensation potentiometer is to be adjusted until the two readings are the same. See Figure 3-1 for location of this potentiometer.

RANGING

Three-range instruments have two ranging adjustments; four range instruments have three adjustments. Figure 3-1 shows the locations. Steps 1 through 9 are for four-range models only. Beginning with Step 10, the procedure applies to all models.

10-Volt Range

1. Set the ratio box at 10:1.

2. Set the voltmeter controls as follows:

   VOLTS, FILTER OUT
   SENS, HI
   RANGE, AUTO
   FUNCTION, DC
   PRINT, OFF

NOTE

Not all four-range instruments have all the controls listed. Disregard reference to non-existent controls.

3. Connect the input cable of the voltmeter to the output of the ratio box.

4. Connect a stable source of about 9 (but less than 10) volts to the input of the ratio box.

5. Record the value displayed on the readout.

6. Disconnect the input of the voltmeter from the output of the ratio box and reconnect it to the input of the ratio box.

7. Record the value displayed on the readout.

8. If the values recorded in Steps 5 and 7 are identical, except for decimal-point position, the 10-volt range is properly adjusted. Example: If the reading in Step 5 is .9876, then the reading in Step 7 must be 9.876.

9. If the values recorded in Steps 5 and 7 are not identical, then the 10-volt range potentiometer (shown in Figure 3-1) must be adjusted. This potentiometer is to be adjusted only when the signal is unattenuated; that is, when the reading in Step 7 is made.

100-Volt Range

WARNING

Use extreme caution in performing the following steps as dangerously high voltages will be employed.

10. Follow Steps 1, 2, and 3. (All models)

11. Connect a stable source of about 95-99 (but less than 100) volts to the input of the ratio box.

12. Record the value displayed on the readout.

13. Disconnect the input of the voltmeter from the output of the ratio box, and reconnect it to the input of the ratio box.

14. Record the value displayed on the readout.

15. If the values recorded in Steps 12 and 14 are identical, except for decimal-point position, the 100-volt range is properly adjusted. Example: If the reading in Step 12 is 9.876, then the reading in Step 14 must be 98.76.

16. If the values recorded in Steps 12 and 14 are not identical (except for decimal-point position), then the 100-volt range must be adjusted. This potentiometer is to be adjusted only when the signal is unattenuated; that is, when the reading in Step 14 is made.

1000-Volt Range

WARNING

Use extreme caution in performing the following steps as dangerously high voltages will be employed.

17. Follow the procedure given for the 100-volt range except set the ratio box to 100:1, apply 950-999 volts and seek digital correspondence. Example: If the unattenuated voltage is 987.6 volts, the attenuated value must be 9.876 volts. Adjust the 1000-volt range potentiometer if necessary; keep in mind that the adjustment is made only when the signal is unattenuated.

Standardization

22. Set the voltmeter controls to the position described in Step 2.

23. Connect the 9-volt standard-cell bank to the input cable, RED to positive, BLACK to negative. The display should read the voltage of the cells; if it does not, adjust the REF ADJ potentiometer (location shown in Figure 3-1) until the display correctly reads the value of the standard cells. Use an insulated shaft screwdriver

since the passage through the board to the potentiometer is close to circuits against which a metal blade could short. When this step is completed, the instrument is in calibration.

CHAPTER IV

MAINTENANCE

If the Digital Voltmeter is not working properly, or if it cannot be calibrated according to instructions, service will be required.

Before seeking out specific defective components, it is best to establish that the power supplies are working. Specifically, voltage checks should be made at the voltage output points of the power supplies as indicated on the schematic drawings. A simple 20,000 ohm-per-volt d'Arsonval type meter may be used for these measurements. The voltage measurements should indicate correct values ±15% when read on a voltmeter with a rated accuracy of ±13%. The outputs of the regulated power supplies cannot be accurately read by this method, but in practice the accuracy of their outputs need not be known; if a regulated power supply fails, it is most likely that the voltage error will be gross (or there will be no output at all) and therefore detectable with simple measuring instruments.

If a measured voltage appears to be at an improper value, the associated power supply components should be checked: if none of these are found to be defective, it will be necessary to proceed along the defective power path, checking wiring, connectors, printed circuitry, and finally components on the boards. An obvious way to make a speedy check is to replace suspected defective boards with known good ones. Since the decade boards are all interchangeable (except as noted on page 1-1), a malfunction affecting one decade of the readout can be made to affect other decades. For this reason, it is suggested that a trial and error approach be used and the decade boards be interchanged. If the malfunction then manifests itself in a previously unaffected decade, the defective board can be readily isolated. From this point on, a test of components will locate the precise area of failure.

If is suggested that the individual schematics be studied so as to better know what outputs may be expected at each function.

APPENDIX

SHIPPING INSTRUCTIONS

Depending upon location, the choice of carrier will vary. Never ship an instrument to us without having received shipping instructions. If requested, an estimate of charges can be made before work begins.

Be certain to pack the instrument carefully; while an outer and inner box, separated by two or three inches of excelsior is desirable, the instrument can be placed into a single container provided it is so packed that it will not shift about. As with the double box method, use two or three inches of shock-absorbent packing materials. The instrument itself should be first wrapped in heavy paper so as to keep excelsior or other particles from entering the instrument's louvers. If the original shipping container is in good condition, it may be used.

CLAIM FOR DAMAGE IN SHIPMENT

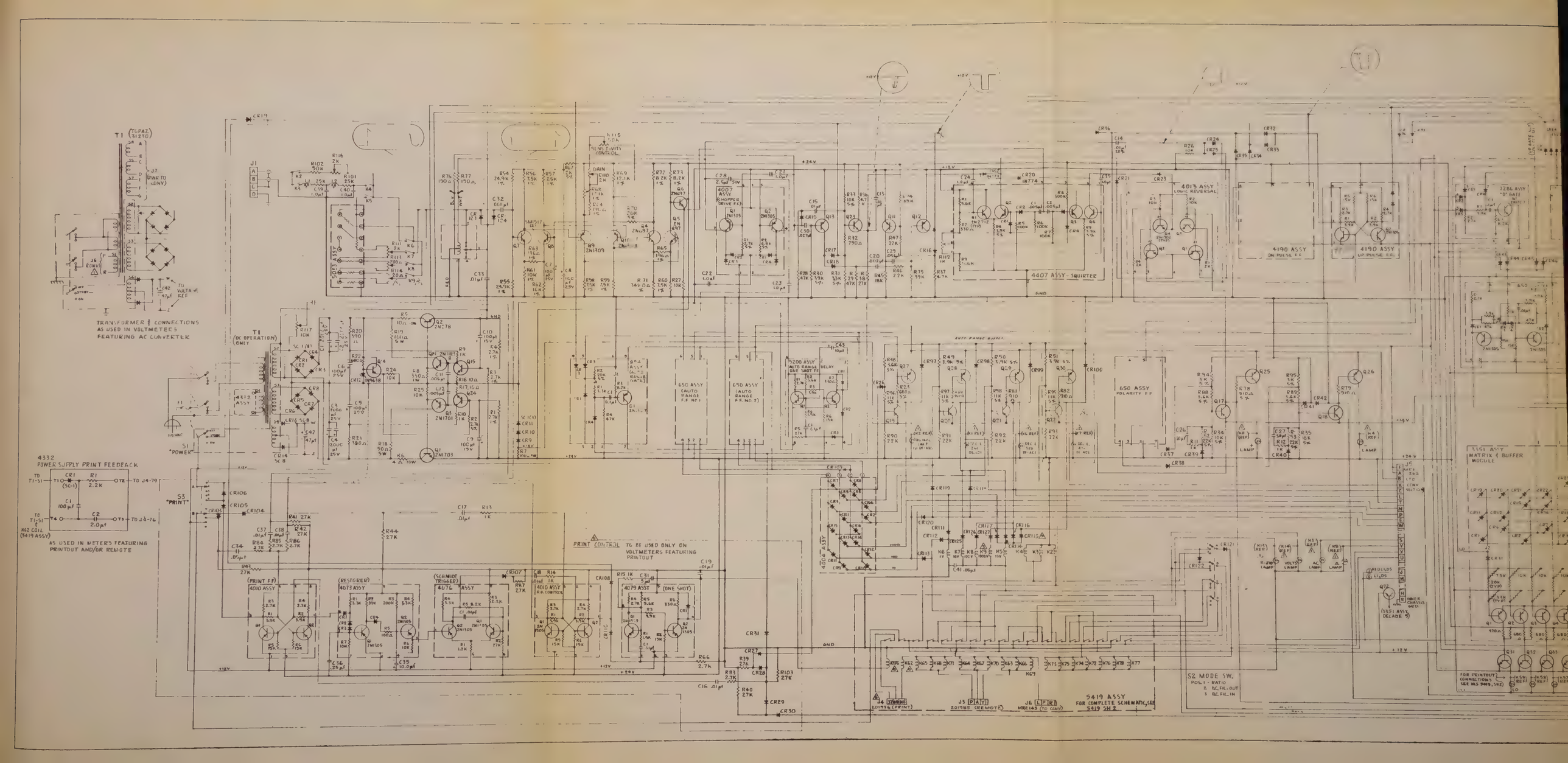
The instrument should be tested as soon as it is received. If it does not operate or is damaged, a claim should be made with the carrier. The claim agent should receive a full report of damage, and this report sent to Non-Linear Systems, Inc. After receiving such a report we will advise you of the disposition of the instrument and arrange for its repair or replacement. Be certain to include model and serial number when corresponding.

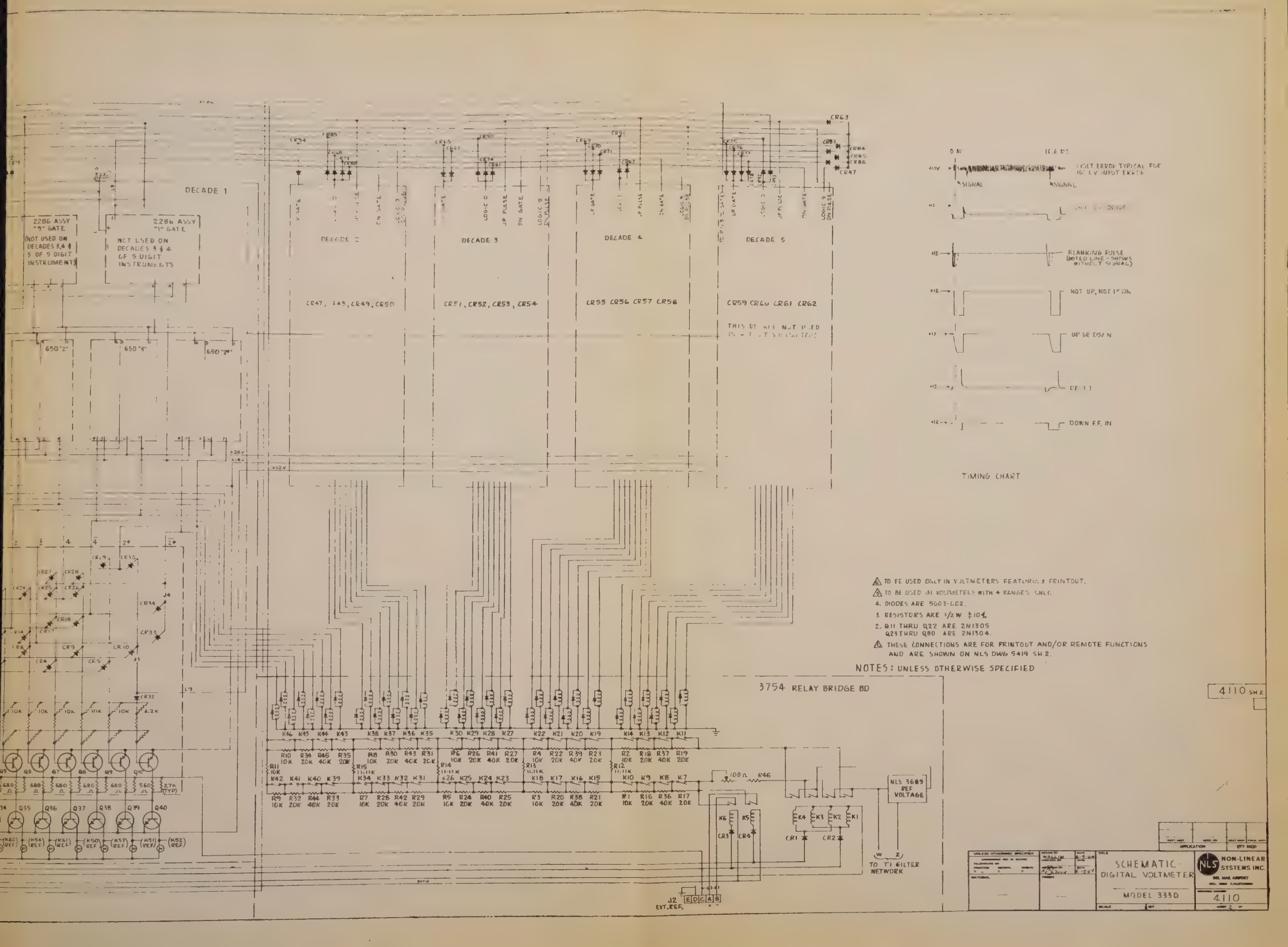
5. DECADE 1 OMITTED ON 4 DIGIT VOLTMETER.
4. RESISTORS ARE NLS TYPE AW1224.
3. DIODES ARE 5003-002.
2. R46 TO BE SELECTED FOR VALUE AT TIME OF NEXT ASSEMBLY.
1. THIS ASSEMBLY IS BUILT ON 3752 (E) P.C. BOARD AND IS USED WITH 4110 CHANGE 1 (OVER RANGING).

NOTES

UNLESS OTHERWISE SPECIFIED	DRAWN BY WALSH	DATE 2-17-66	TITLE
DIMENSIONS ARE IN INCHES	CHECKED BY	DATE	SCHEMATIC
TOLERANCES ON FRACTION DECIMAL ANGLES	APPROVED BY	DATE 2-17-66	BRIDGE RELAY BOARD ASSY
MATERIAL	FINISH		SERIES 3300
SCALE	WT		DRAWING NUMBER 33-46 SHEET 2 OF

NON-LINEAR SYSTEMS INC. DEL MAR AIRPORT DEL MAR, CALIFORNIA


TRANSFORMER & CONNECTIONS AS USED IN VOLTMETERS FEATURING AC CONVERTER
4332 POWER SUPPLY PRINT FEEDBACK
AS USED IN METERS FEATURING PRINTOUT AND/OR REMOTE
PRINT CONTROL TO BE USED ONLY ON VOLTMETERS FEATURING PRINTOUT
4407 ASSY - SQUIRTER
4013 ASSY LOGIC REVERSAL
4190 ASSY
650 ASSY POLARITY FF
5200 ASSY AUTO RANGE DELAY
5419 ASSY
S2 MODE SW.
POS. 1 - RATIO
2 - RC FIL. OUT
3 - RC FIL. IN
3351 ASSY MATRIX & BUFFER MODULE
7284 ASSY "D" GATE


DECADE 1
DECADE 2
DECADE 3
DECADE 4
DECADE 5
2286 ASSY "9" GATE
(NOT USED ON DECADES 3 & 5 OF 5 DIGIT INSTRUMENTS)
2286 ASSY "1" GATE
NOT USED ON DECADES 3 & 4 OF 5 DIGIT INSTRUMENTS
CR47, CR48, CR49, CR50
CR51, CR52, CR53, CR54
CR55 CR56 CR57 CR58
CR59 CR60 CR61 CR62
THIS DIODE NOT USED IN 4 DIGIT INSTRUMENTS
650 "2"
650 "4"
650 "8"
+24V
+16V
+12V
J4
J3
J2
EXT. REF.
3754 RELAY BRIDGE BD
NLS 3689 REF VOLTAGE
TO T1 FILTER NETWORK
100Ω R46
K1 K2 K3 K4 K5 K6
CR1 CR2 CR3 CR4
Q1 Q2 Q3 Q4 Q5 Q6 Q7 Q8 Q9 Q10
Q35 Q36 Q37 Q38 Q39 Q40
(K60 REF) (K54 REF) (K61 REF) (K50 REF) (K53 REF) (K51 REF) (K52 REF)

TIMING CHART

NOTES: UNLESS OTHERWISE SPECIFIED

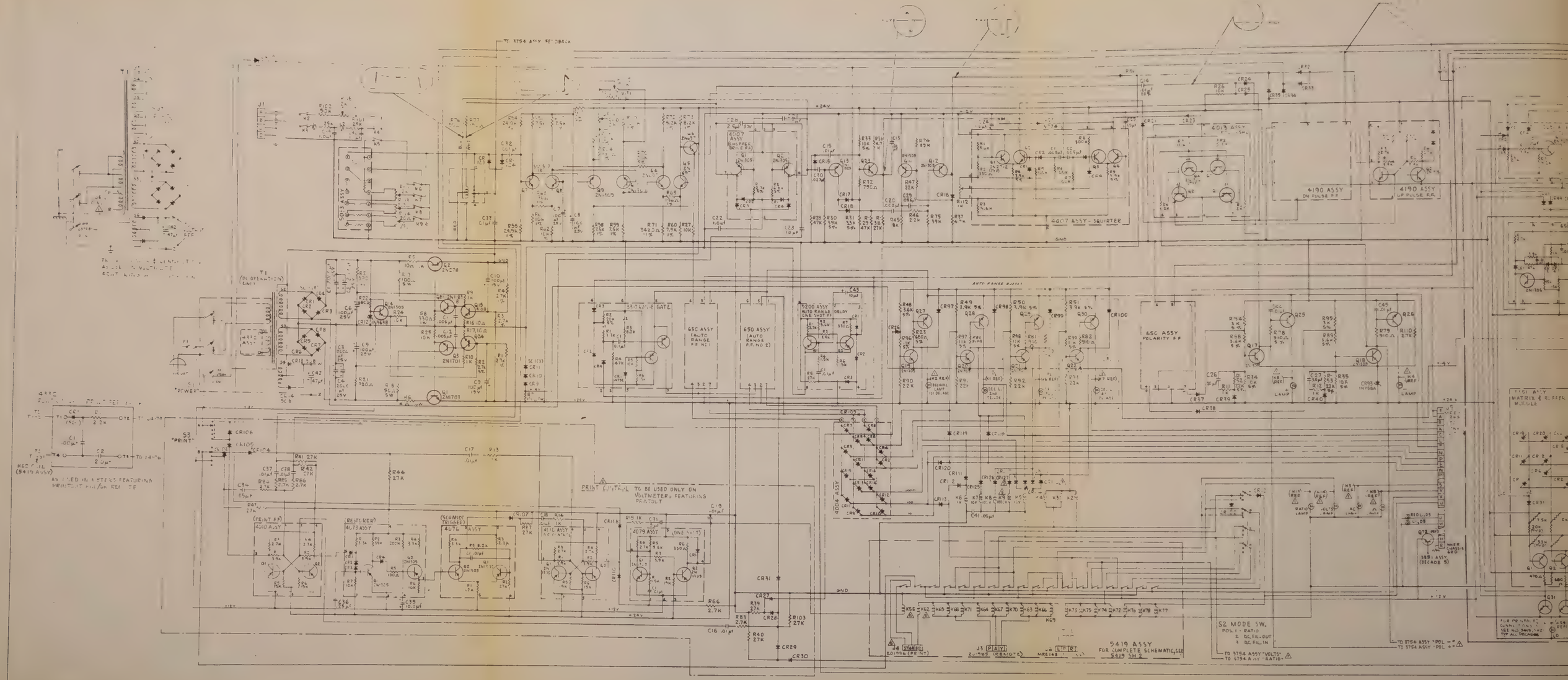
4. DIODES ARE 5003-002.
3. RESISTORS ARE 1/2W ±10%.
2. Q11 THRU Q22 ARE 2N1305
   Q23 THRU Q80 ARE 2N1304.

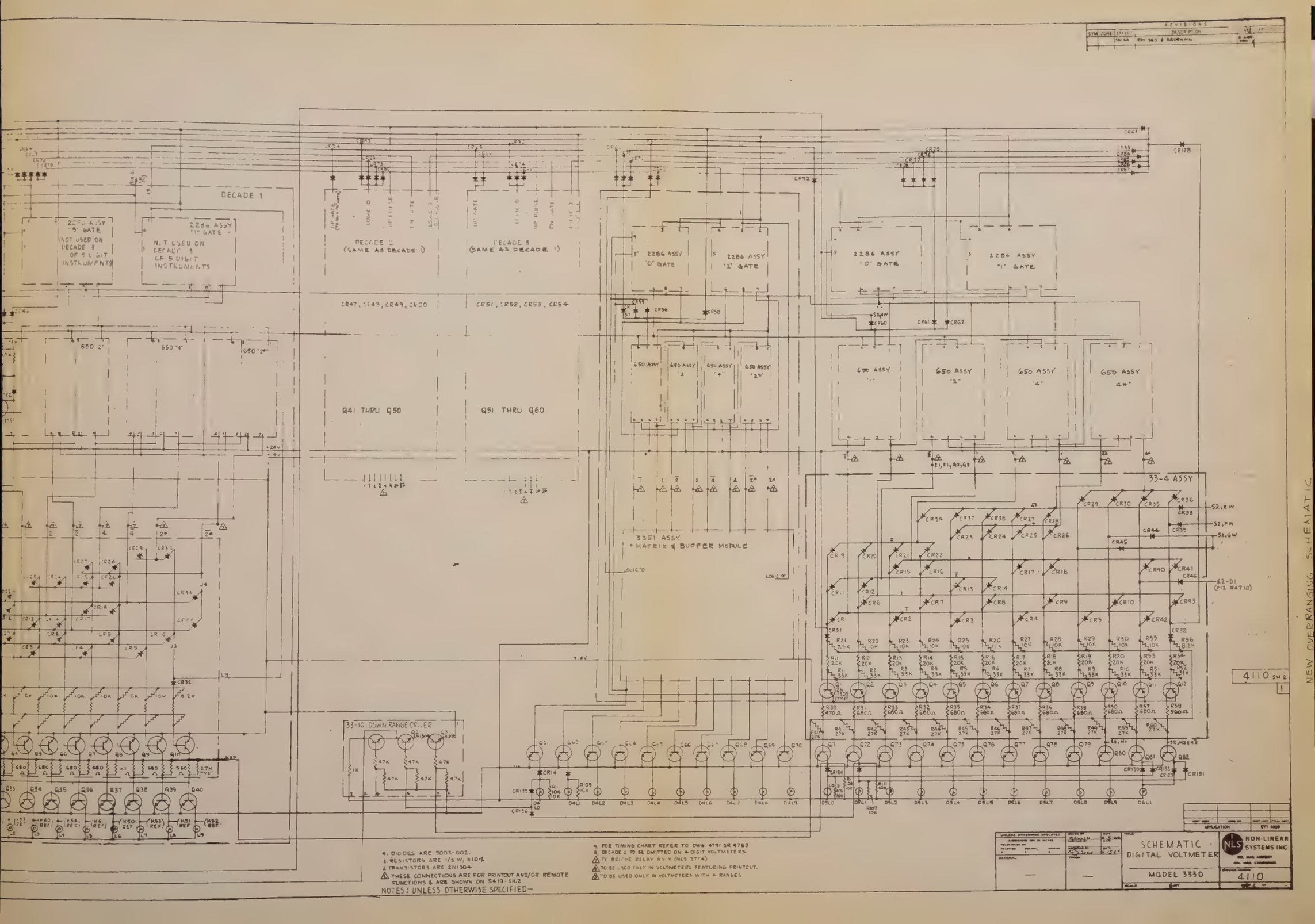
⚠ TO BE USED ONLY IN VOLTMETERS FEATURING PRINTOUT.
⚠ TO BE USED IN VOLTMETERS WITH 4 RANGES ONLY.
⚠ THESE CONNECTIONS ARE FOR PRINTOUT AND/OR REMOTE FUNCTIONS AND ARE SHOWN ON NLS DWG 5419 SH 2.

4110 SH 2

				APPLICATION	QTY REQD

UNLESS OTHERWISE SPECIFIED	DRAWN BY R. ALLEN	DATE 6-5-68	TITLE SCHEMATIC - DIGITAL VOLTMETER	NLS NON-LINEAR SYSTEMS INC. BIG BEAR AIRPORT OCEANSIDE, CALIFORNIA
	CHECKED BY R. Allen	DATE 6-5-68	MODEL 3330	4110
			SCALE	SHT 2 OF 2


4007 ASSY - SQUIRTER
4190 ASSY
UP PULSE F.F.
4190 ASSY
DN PULSE F.F.
650 ASSY
(AUTO RANGE F.F. NO. 2)
65C ASSY
(AUTO RANGE F.F. NO.1)
5200 ASSY
AUTO RANGE DELAY
(ONE SHOT FF)
33-7 NAND GATE
65C ASSY
POLARITY F.F.
4006 ASSY
4079 ASSY
(ONE SHOT)
4078 ASSY
(SCHMIDT TRIGGER)
4073 ASSY
(RESTORER)
4010 ASSY
(PRINT F.F.)
5419 ASSY
FOR COMPLETE SCHEMATIC, SEE 5419 SH 2
S2 MODE SW.
POS. 1 - RATIO
2 DC FIL-OUT
3 DC FIL-IN
PRINT CONTROL TO BE USED ONLY ON VOLTMETERS FEATURING PRINTOUT
AUTO RANGE BUSS
GND
+34V
+24V
+12V
+5V
+16V
+8V
-12V
-24V
TO 3754 ASSY FEEDBACK
TO 3754 ASSY "POL -"
TO 3754 ASSY "POL +"
TO 3754 ASSY "VOLTS"
TO 3754 ASSY "RATIO"
TO 3754 ASSY MATRIX & REFERENCE MODULE
POWER
S3 "PRINT"
S1 "POWER"
J3 PRINT
J4 STROBE
J5 LIR
J6 MREIAS
T1 (DC OPERATION UNIT)
T2 (AC OPERATION UNIT)
RATIO LAMP
VOLTS LAMP
AC LAMP
DC LAMP
LAMP
REF
RED LIPS
INNER CHASSIS GND
OUTER CHASSIS GND



4. DIODES ARE 5003-002.
3. RESISTORS ARE 1/2 W, ±10%
2. TRANSISTORS ARE 2N1304
⚠1 THESE CONNECTIONS ARE FOR PRINTOUT AND/OR REMOTE FUNCTIONS & ARE SHOWN ON 5419 SH.2

NOTES: UNLESS OTHERWISE SPECIFIED—

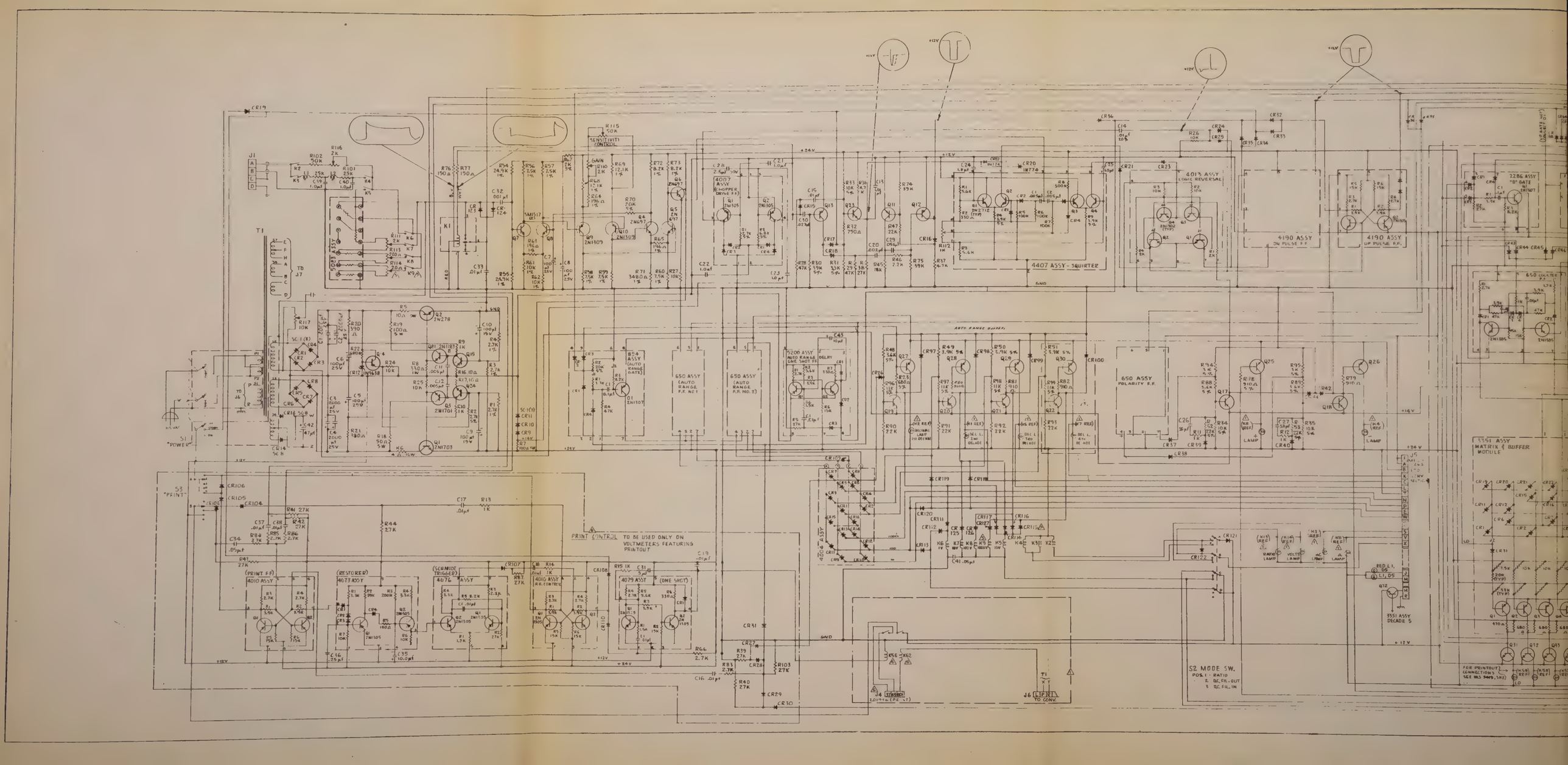
⚠2 FOR TIMING CHART REFER TO DWG 4791 OR 4783
⚠3 DECADE 1 TO BE OMITTED ON 4 DIGIT VOLTMETERS
⚠4 TC BRIDGE RELAY ASSY (NLS 3774)
⚠5 TO BE USED ONLY IN VOLTMETERS FEATURING PRINTOUT.
⚠6 TO BE USED ONLY IN VOLTMETERS WITH 4 RANGES

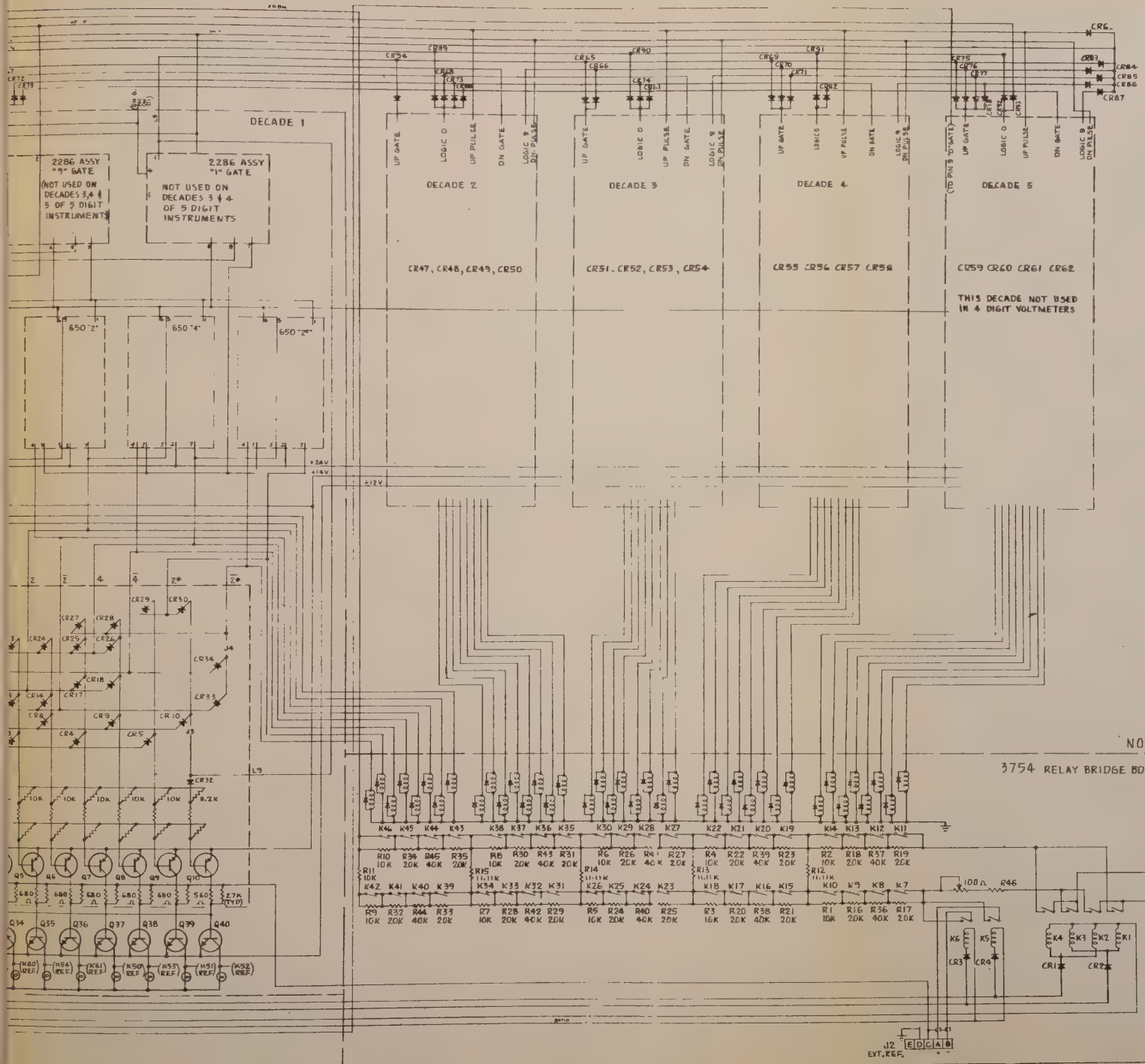
UNLESS OTHERWISE SPECIFIED
DRAWN BY R.A.H.
DATE 4-3-68
CHECKED BY
DATE
MATERIAL —
FINISH —

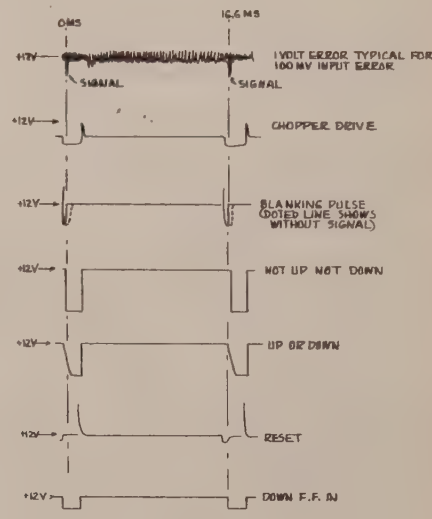
TITLE
SCHEMATIC · DIGITAL VOLTMETER
MODEL 3330

NON-LINEAR SYSTEMS INC
DEL MAR, CALIFORNIA

DRAWING NO. 4110


4407 ASSY - SQUIRTER
4013 ASSY LOGIC REVERSAL
4190 ASSY DN PULSE F.F.
4190 ASSY UP PULSE F.F.
2286 ASSY "D" GATE W/ INTOUT
650 COUNTER F.F.
650 ASSY POLARITY F.F.
650 ASSY (AUTO RANGE F.F. NO. 1)
650 ASSY (AUTO RANGE F.F. NO. 2)
5200 ASSY AUTO RANGE DELAY ONE SHOT F.F.
854 ASSY (AUTO RANGE GATE)
4007 ASSY (CHOPPER DRIVE F.F.)
4010 ASSY (PRINT F.F.)
4073 ASSY (RESTORER)
4076 ASSY (SCHMIDT TRIGGER)
4010 ASSY (R.O. CONTROL)
4079 ASSY (ONE SHOT)
4004 ASSY
5351 ASSY MATRIX & BUFFER MODULE
5351 ASSY DECADE 5
S1 "POWER"
S2 MODE SW.
POS 1 - RATIO
2 - DC FIL. OUT
3 - DC FIL. IN
S3 "PRINT"
PRINT CONTROL TO BE USED ONLY ON VOLTMETERS FEATURING PRINTOUT
SENSITIVITY CONTROL
GAIN
AUTO RANGE BUFFERS
TO CONV.
FOR PRINTOUT CONNECTIONS SEE MLS 5409, 5412
+12V
+24V
GND





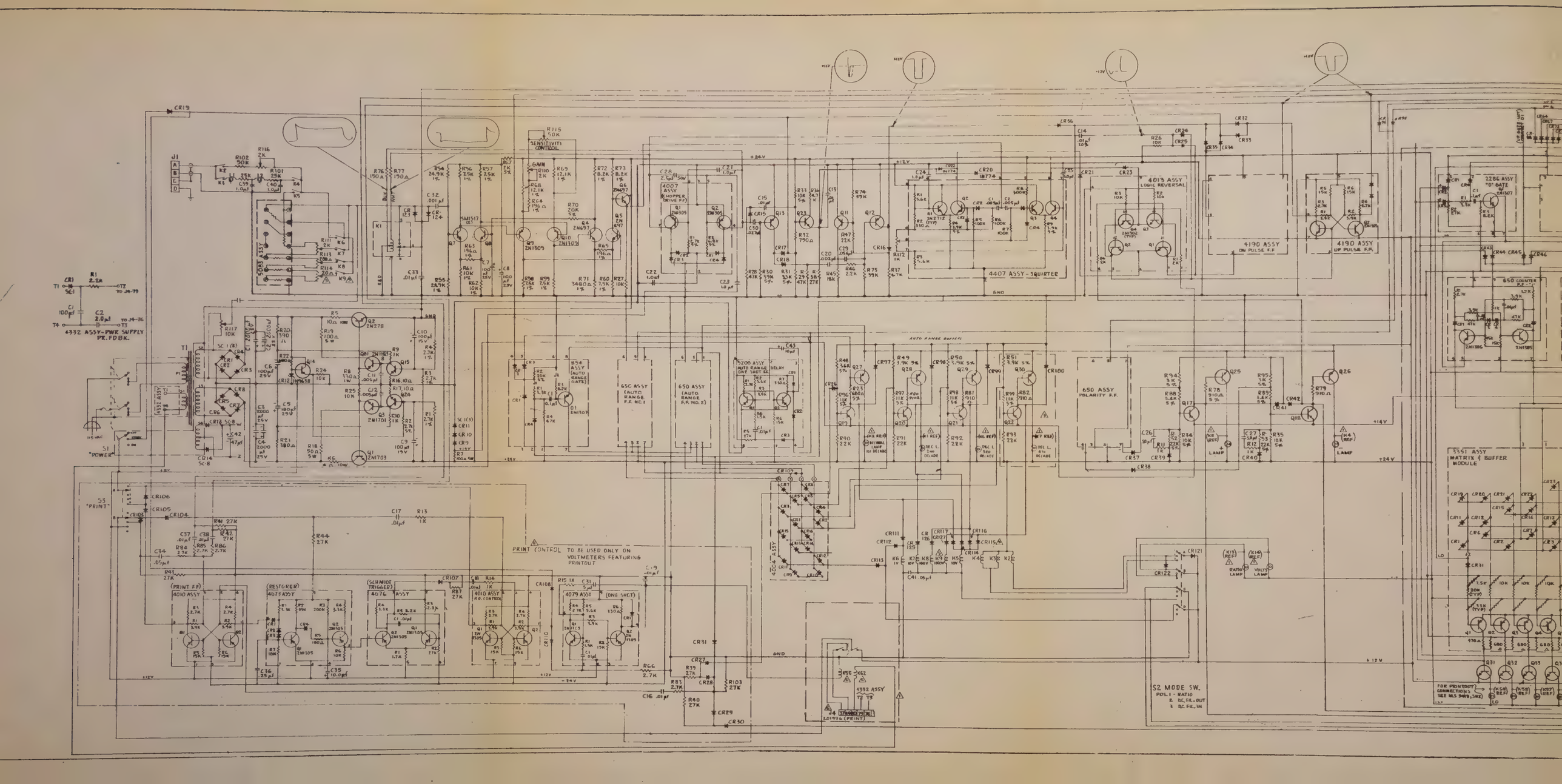
TIMING CHART

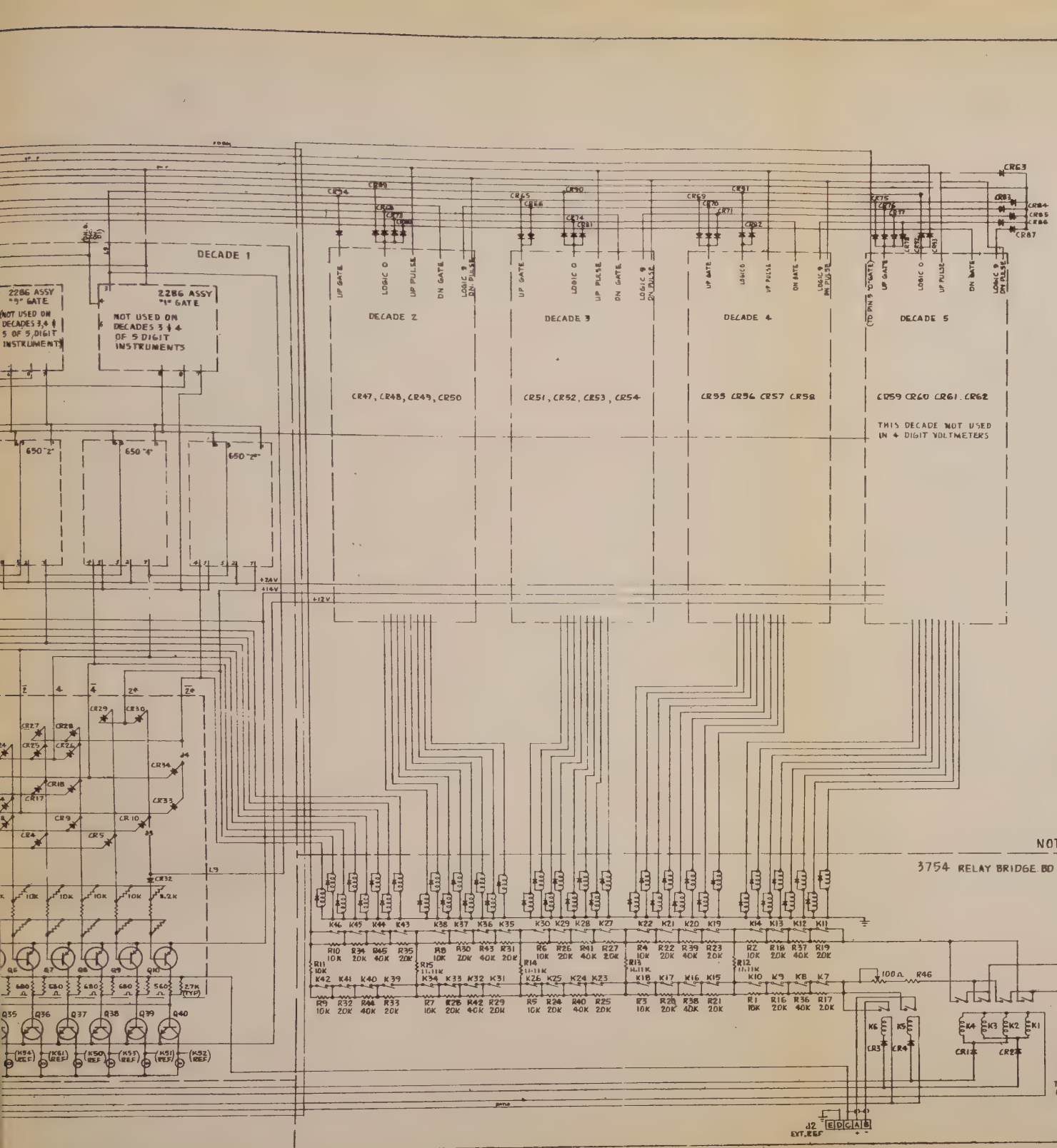
⚠ TO BE USED ONLY IN VOLTMETERS FEATURING PRINTOUT.
⚠ TO BE USED IN VOLTMETERS WITH 4 RANGES ONLY.
4. DIODES ARE 5003-002.
3. RESISTORS ARE 1/2 W ±10%.
2. Q11 THRU Q22 ARE 2N1305
Q23 THRU Q80 ARE 2N1304.
⚠ THESE CONNECTIONS ARE FOR PRINTOUT AND ARE SHOWN ON NLS DWG 5419 SH 2.

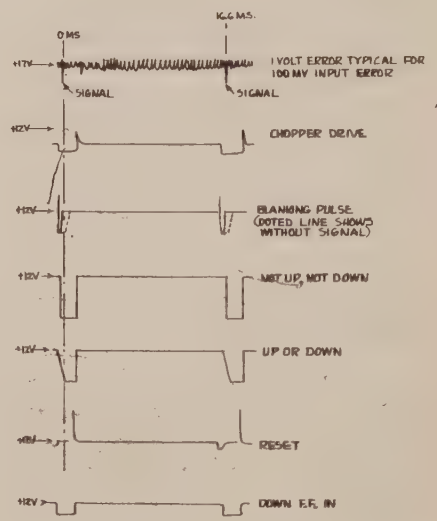
NOTES: UNLESS OTHERWISE SPECIFIED

4783 SH 2

UNLESS OTHERWISE SPECIFIED	DRAWN BY A.E. WALLIN 9-20-64	TITLE SCHEMATIC- DIGITAL VOLTMETER	NON-LINEAR SYSTEMS INC	APPLICATION
		MODEL 3333	4783	QTY REQD


4332 ASSY-PWR SUPPLY PR.FDBK.
4007 ASSY (CHOPPER DRIVE F/F)
4407 ASSY-SQUIRTER
4013 ASSY LOGIC REVERSAL
4190 ASSY DN PULSE F/F
4190 ASSY UP PULSE F/F
2286 ASSY "D" 6472
650 COUNTER P.C.
5200 ASSY (AUTO RANGE ONE SHOT &)
650 ASSY (AUTO RANGE F/F NO. 2)
650 ASSY (AUTO RANGE F/F NO.1)
650 ASSY POLARITY F/F
3351 ASSY MATRIX & BUFFER MODULE
4010 ASSY (PRINT F/F)
4011 ASSY (RESTORER)
4076 ASSY (SCHMIDT TRIGGER)
4079 ASSY (ONE SHOT)
AUTO RANGE BUFFER
PRINT CONTROL TO BE USED ONLY ON VOLTMETERS FEATURING PRINTOUT
S2 MODE SW.
POS. 1 - RATIO
2 DC FIL. OUT
3 DC FIL. IN
FOR PRINTOUT CONNECTIONS SEE MLS 5989, 5992
SENSITIVITY CONTROL
GAIN
RATIO LAMP
VOLTS LAMP
LAMP
+24V
+12V
-24V
-12V
GND





TIMING CHART

⚠ TO BE USED ONLY IN VOLTMETERS FEATURING PRINTOUT.
⚠ TO BE USED IN VOLTMETERS WITH 4 RANGES ONLY.
4. DIODES ARE 5003-002.
3. RESISTORS ARE 1/2W ±10%
2. Q11 THRU Q22 ARE 2N1305
Q23 THRU Q80 ARE 2N1304.
⚠ THESE CONNECTIONS ARE FOR PRINTOUT AND ARE SHOWN ON NLS DWG 5419 SH 2.

NOTES: UNLESS OTHERWISE SPECIFIED

4791 SH 2

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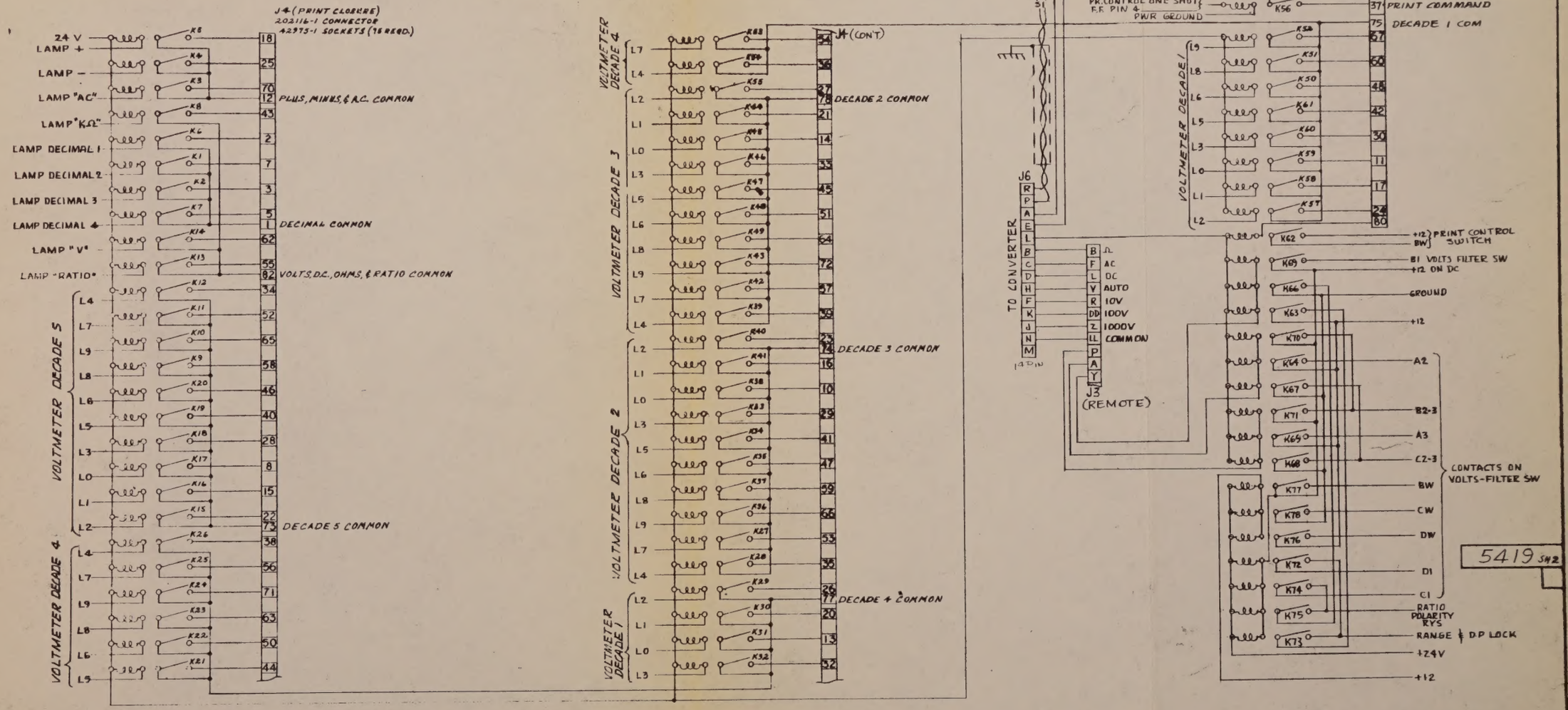
REVISIONS					
SYM	ZONE	EFFECT.	DESCRIPTION	DATE	APPROVED



QTY REQD	PART OR IDENTIFYING NO.	NOMENCLATURE OR DESCRIPTION	MFR. CODE	CIRCUIT REF.	ITEM NO.	NEXT ASSY.	FINAL ASSY.	NEXT ASSY.	FINAL ASSY.
PARTS LIST						APPLICATION		QTY.	

UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES
TOLERANCES ON
DECIMALS ± .010
ANGLES ± 0° 30'
FRACTIONS ± 1/32
SURFACE ROUGHNESS PER MIL-STD-10 ✓
DO NOT SCALE THIS DRAWING
RELEASE DATE 6-18-64 (E)

DRAWN J.A.COMBS 4-19-64
CHECK
APPR [signature] 5-21-64
MATERIAL —
FINISH —

NON-LINEAR SYSTEMS, INC.
DEL MAR, CALIFORNIA

SCHEMATIC

PRINT CLOSURE AND REMOTE FUNCTION

MODEL 3800 SERIES

CODE IDENT NO. 03626 | SIZE D | 5419

SCALE | WEIGHT | SHEET 2

1. .1V RANGE NOT USED W/5 DIGIT D.V.M. OR A.C. CONVERTER. (PIN "S")

NOTES, UNLESS OTHERWISE SPECIFIED:

non linear
systems, inc.

DEL MAR, CALIFORNIA

MP MASTER
MA33779